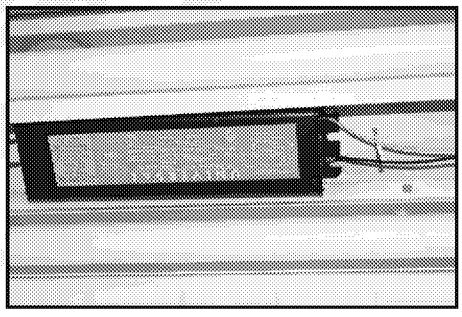
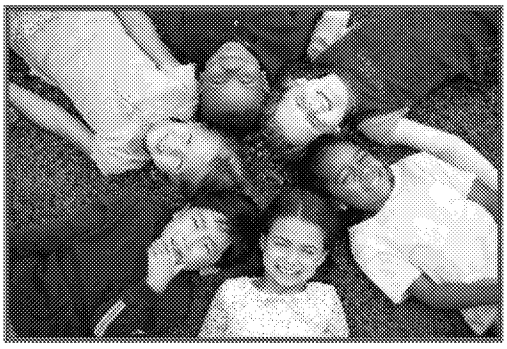
PCBs
in Lighting Fixtures in Schools

Updated February 5, 2013



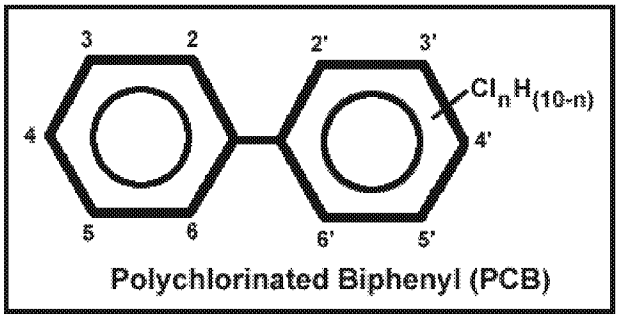
Win-Win-Win-Win



Save energy and save tax dollars—Prevent exposure to cancer causing PCBs—Create jobs—Private sector funding source

What are PCBs?

- Polychlorinated biphenyls
- Man-made organic chemicals
- Industrial and commercial applications



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PCBs, or polychlorinated biphenyls, are human-made organic chemicals that were used in hundreds of industrial and commercial applications before their production was banned and their use restricted

Health Effects of PCBs

- Probable human carcinogen
- Cause cancer in animals
- Serious non-cancer effects on the immune, reproductive, nervous and endocrine systems
- EPA banned the processing or use of PCBs in 1979

Testimonials on the Health Effects of PCBs

At the NYC Council Hearing of the Committees on Education and Environmental Protection
April 13, 2011

New York Committee for Occupational Safety and Health (NYCOSH)

"PCBs in schools constitute a significant health risk for the following reasons: they cause serious chronic health effects, they have been found in air and on surfaces at levels above health-based guidelines, and, unless removed, staff and students will inhale them, ingest them, and absorb them through the skin, for many years."

Mt. Sinai Children's Environmental Health Center

"Well-conducted, highly credible epidemiological studies demonstrate that babies born to mothers with elevated levels of PCBs in their bodies have diminished intelligence as measured by decreased IQ scores and motor delays."

Testimonials on the Health Effects of PCBs

At the NYC Council Hearing of the Committees on Education and Environmental Protection
April 13, 2011

David O. Carpenter, M.D., University at Albany, State University of New York

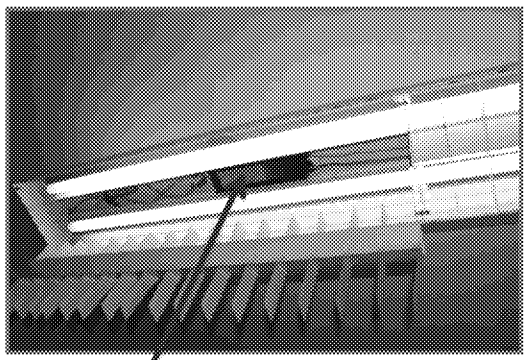
"The health effects known to be associated with exposure to PCBs include cancer (Cogliano, 1998), suppression of immune (Weisglas-Kuperus et al.. 2000) and thyroid (Schell et al., 2008) function, elevated risk of cardiovascular disease (Goncharov et al., 2008) hypertension (Goncharov et al., 2010) and diabetes (Lee et al., 2010)."

"Studies on teachers working in PCB-contaminated schools in Germany have found that their blood showed elevations in the lower-chlorinated PCB congeners that were present in the air (Schwenk et al., 2002), provided proof that humans working in an environment with elevated air-borne PCBs absorb them."

"There is no such thing as a "safe" level of PCBs."

PCB-Containing Ballasts

- Schools built prior to 1979
- Possible leaking of PCB-containing lighting ballasts nation wide

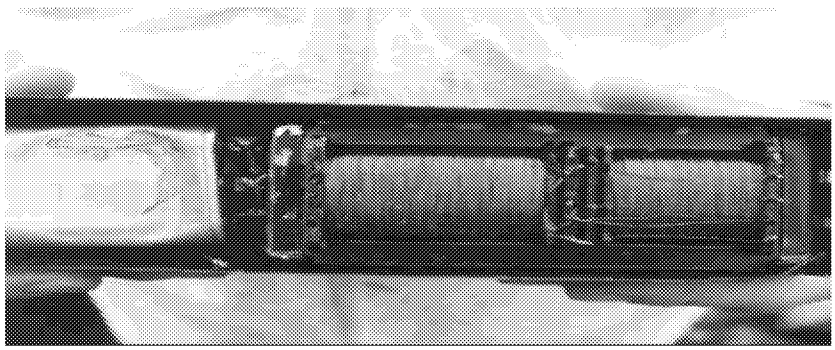


PCB-containing Ballast

This is what you might normally see when looking up at a light. Unfortunately, this PCB containing ballast had evidence of leaking but the light was still working.

Determined that widespread leaking PCB-containing lighting ballasts were contributing to elevated air levels

- Older ballasts have a transformer to reduce voltage, a small capacitor that may contain PCBs, and some have a thermal cut-off switch and/or safety fuse.
- Potting material, a tar-like substance, is used to surround components to muffle the noise of the ballast. This material may also contain PCBs
- If PCBs are present in the capacitor, the amount ranges from approximately 1oz to 1.5 oz
- The ballasts for high intensity discharge (HID) lamps can contain between 3 oz and 14 oz PCBs



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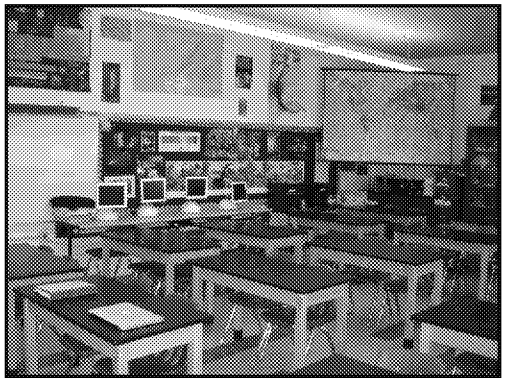
Thermal cut off switches were common place in mid-80s but EPA found thermal cut off switches in some ballasts that were manufactured in the early 70's. These ballasts appeared to have less leaking since they did not get as hot. Unfortunately, if they are leaking and get how, they shut down but after cool down reset and continue to work while leaking.

2009 EPA/NYC Pilot Study



- New York City identified high levels of PCBs in some caulk and other building materials.
- Their testing also identified ballasts as another potential primary source of PCBs.
- Based on pilot study air testing, levels of PCBs in numerous school spaces were above EPA health-based benchmarks.

2011 EPA Inspections of Lighting

- EPA sampled 10 NYC School facilities at 7 locations
- Classrooms and light fixtures were selected at random
- 113 of 145 samples from fixtures tested above EPA regulatory limit of 50 ppm
- Lights still worked with leaking ballasts
- On most types of lighting fixtures, it is difficult to determine by just looking up from floor level that a ballast is leaking

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During January and February 2011, EPA conducted seven inspections of lighting fixtures at public schools in Manhattan, Brooklyn, Staten Island and the Bronx

145 samples taken total

113 samples showed results above the EPA regulatory limit of 50 ppm

At each school, at least two-thirds of the samples taken showed results above the regulatory limit

At on school, two samples showed a result of approximately 1,000,000 ppm, or 100% PCBs

Summary of EPA Sampling Results

School	Borough	Date of Sampling Event	Number of Samples Taken	Number of Samples > 50 ppm (mg/kg)	Range of Exceedances in ppm (mg/kg)
PS 53	Staten Island	1/8/2011	33	22	51 – 260,000
PS 11	Brooklyn	1/15/2011	28	18	51 – 3,000
PS 13 PS 358	Brooklyn	1/22/2011	7	7	70 - 560
PS 68	Bronx	1/29/2011	13	10	61 – 1,260
PS 206 PS 37 PS 112	Manhattan	2/5/2011	10 1 3 (14 total)	9 1 2 (12 total)	95 – 7,600
PS 45	Brooklyn	2/12/2011	19	19	830 –670,000
PS 306	Brooklyn	2/19/2011	31	25	480 – 1,200,000

Exceeds one million parts per million; pure PCBs

PCBs Leaked on a Student's Clothes in PS 41 in Staten Island

- In September 2012 a PCB-containing lighting fixture leaked onto the desk and clothing of a fifth grader at PS 41 R
- The children were evacuated and the light was immediately removed
- NYC replaced all PCB-containing lighting fixtures in the school

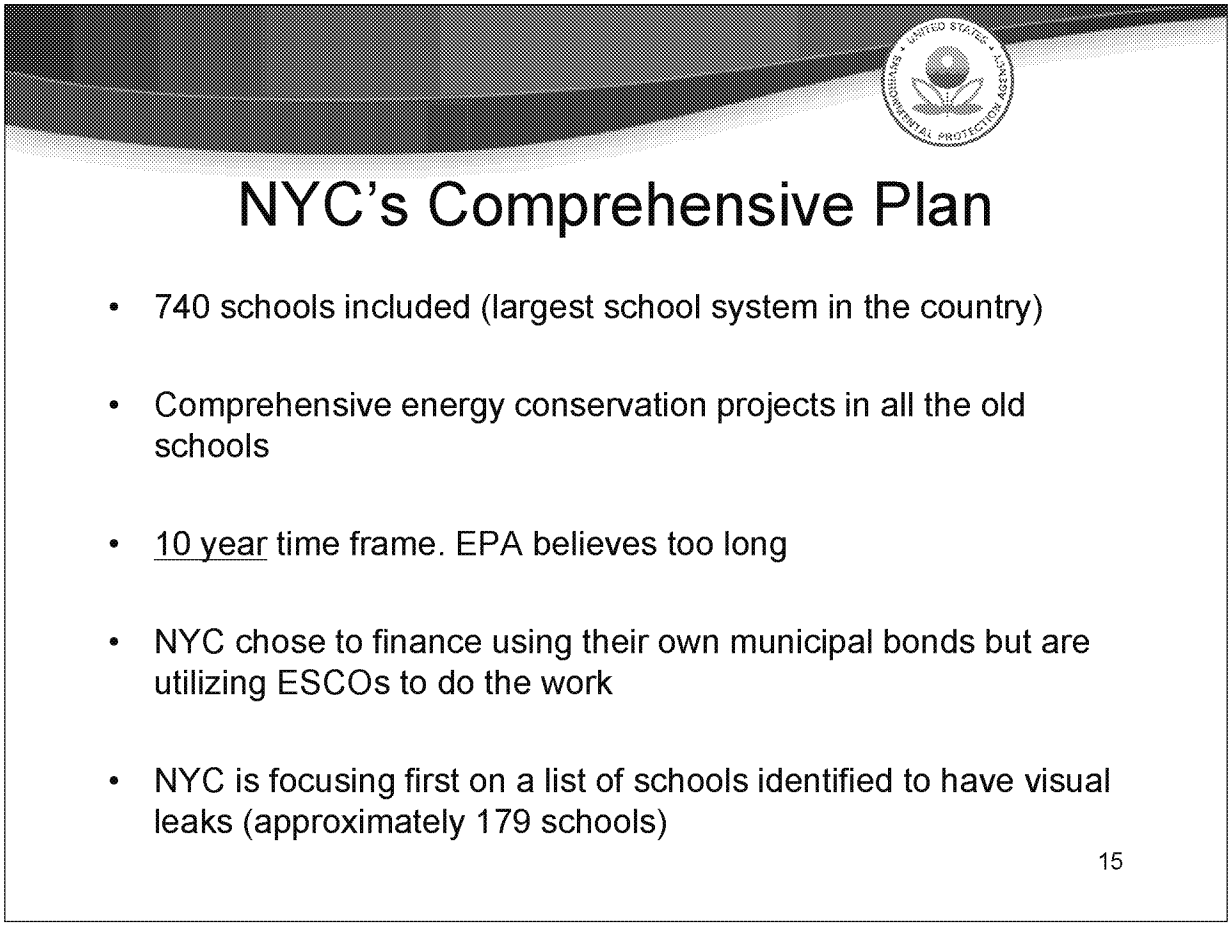
PCB Leak at PS 204 in Queens

- Days after the PCB leak at PS 41, a PCB-containing lighting fixture leaked out of the fixture in a room in PS 204 in Queens.

- This school is being added to NYC's priority list of schools with identified visual leaks.

Ballast Failure at PS 50 in Staten Island

- On January 7 and 14, 2013, failures of light ballasts, including smoking conditions, reportedly occurred at the school.



February 2011 NYC DOE announced its "Comprehensive Plan to Increase Energy Efficiency and Environmental Quality at Schools"

The Plan calls for the removal and replacement of all PCB lighting ballasts throughout the entire school system over the course of ten years

Approximately 740 NYC schools have PCB-containing ballasts

Status of NYC's Lighting Retrofits

- Approximately 92 buildings covering 157 schools/programs have been addressed
- Work is underway on 200 buildings covering 355 schools/programs
- NYC selected 5 ESCOs to perform energy efficiency projects and lighting retrofits
- $20 M per contract, $100 M total
- ESCOs are managed by NYC's School Construction Authority (SCA)
- The SCA is performing the majority of the lighting retrofits

EPA Region 2 Outreach Efforts

- Mailed over 3,500 information packages to school districts and individual non-public schools encouraging inspections to identify school buildings at risk

- Continue to provide outreach and technical assistance to districts and schools requesting our assistance

EPA National Outreach Efforts

- In December 2010 EPA released national guidance recommending that schools remove older PCB-containing lighting ballasts

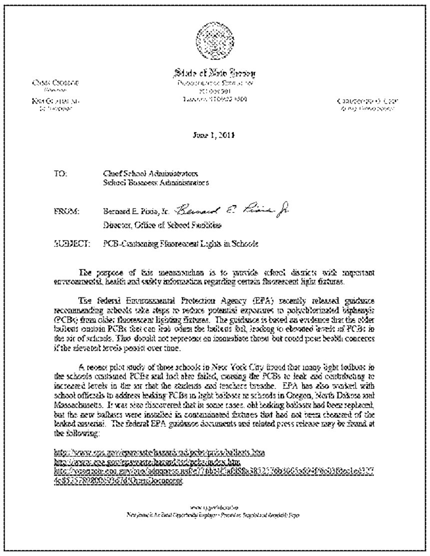
http://www.epa.gov/epawaste/hazard/tsd/pcbs/pubs/ballasts.htm

- EPA's Office of Research and Development continues work to identify and evaluate encapsulation products, in-place PCB containing materials and remediation methods

  Link to ORD's PCB Research Overview:

http://www.epa.gov/wastes/hazard/tsd/pcbs/pubs/caulk/pdf/PCBs_Comprehensive_Overview_1-8-2013.pdf

2011 New Jersey Department of Education Letter



State of New Jersey

June 1, 2011

TO: Chief School Administrators
School Business Administrators

FROM: Bernard E. Piaia, Jr.
Director, Office of School Facilities

SUBJECT: PCB-Containing Fluorescent Lights in Schools

The purpose of this memorandum is to provide school districts with important environmental, health and safety information regarding certain fluorescent light fixtures.

The federal Environmental Protection Agency (EPA) recently released guidance recommending schools take steps to reduce potential exposures to polychlorinated biphenyls (PCBs) from older fluorescent lighting fixtures. The guidance is based on evidence that the older ballasts contain PCBs that can leak when the ballasts fail, leading to elevated levels of PCBs in the air of schools. This should not represent an immediate threat but could pose health concerns if the elevated levels persist over time.

A recent pilot study of three schools in New York City found that many light ballasts in the schools contained PCBs and had also failed, causing the PCBs to leak and contributing to increased levels in the air that the students and teachers breathe. EPA has also worked with school officials to address leaking PCBs in light ballasts in schools in Oregon, North Dakota and Massachusetts. It was also discovered that in some cases, old leaking ballasts had been replaced, but the new ballasts were installed in contaminated fixtures that had not been cleaned of the leaked material. The federal EPA guidance documents and related press release may be found at the following:

http://www.epa.gov/epawaste/hazard/tsd/pcbs/pubs/ballasts.htm
http://www.epa.gov/epawaste/hazard/tsd/pcbs/index.htm
[illegible]

Letter to all NJ Chief School Administrators and Business Administrators referencing the EPA national guidance and recommending that schools "survey and inventory all light fixtures in schools built before 1979 and develop a plan to replace those identified to contain PCBs within the ballasts."

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Other Agencies in Region 2 (NY and NJ) are issuing guidance information.

NJ Dept. Of Health and Senior Services

From statement on NJDDHSS website:

"It is necessary for schools to inspect and replace any leaking light fixtures to reduce the potential for exposures to school occupants."

New York State Education Dept.

Excerpt from NYSED's Office of Facilities Planning, May 2011 Newsletter:

"The department recommends that school districts take a prudent approach to potential PCB contamination and inspect lighting systems in particular to investigate whether PCBs exist in the facility."

Lighting Fixture Warning Signs

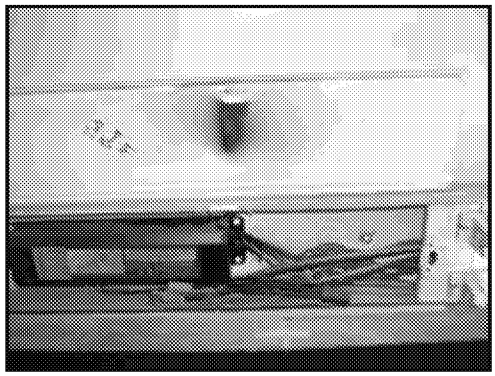
- Burned –out lights that don't work after bulbs are changed
- Evidence of oil stains on light fixture housing, floor tiles or carpeting below light fixtures
- Previous incidents of smoke or burning odors requiring custodians to service lights
- Previous incidents where custodians removed or took apart a fixture to replace parts.

T- 12 Fixtures with smoke, Burning Odors or Dripping Oil

- Evacuate room and isolate: close doors and open windows to ventilate space including ventilate prior to re-occupancy
- Fan to exhaust through windows can help
- Prevent recirculation of air
- Turn off power to fixture; remove bulbs
- Inspect fixtures and follow steps for PCB fixture remediation (done by an environmental consultant/contractor)

Types of Ballast Failures

This ballast sparked a fire at a southern California school in 1999



An old ballast that burst unexpectedly

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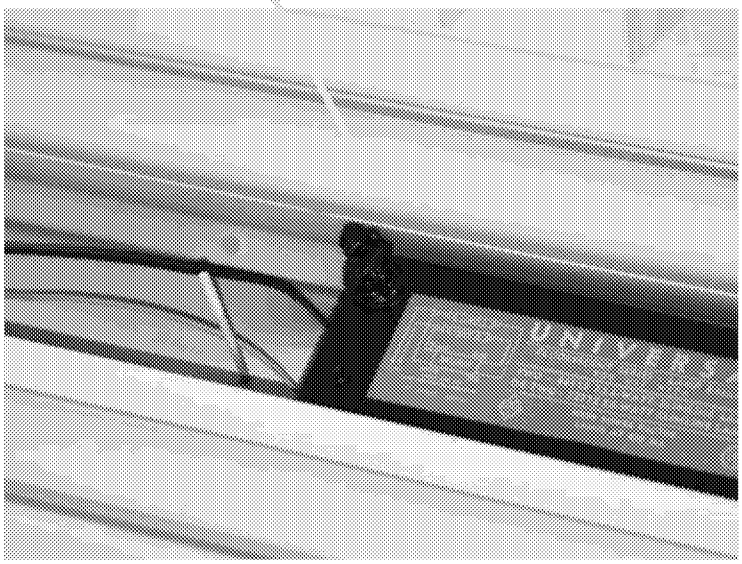
During our inspections we found similar types of ballast failures.

Material Leaking From Corner of Ballast



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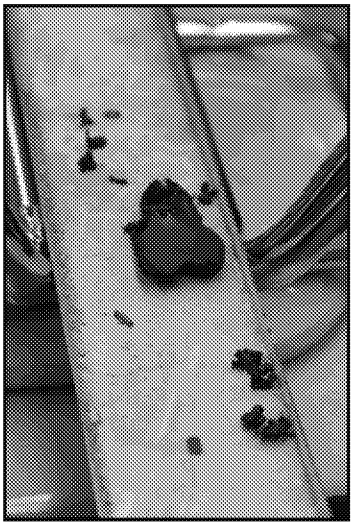
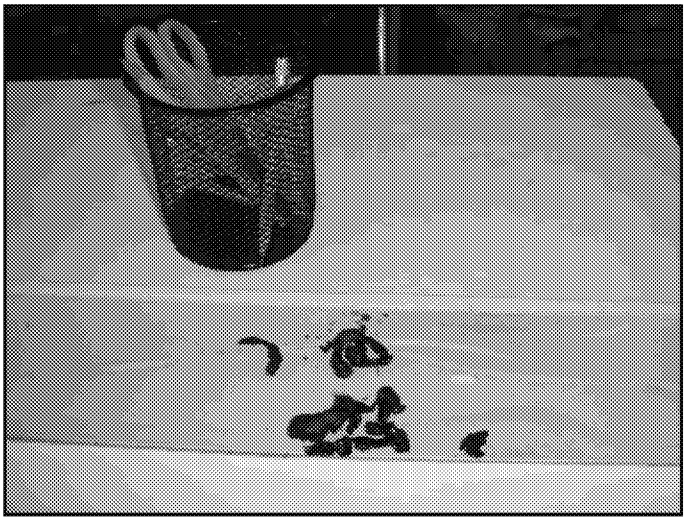
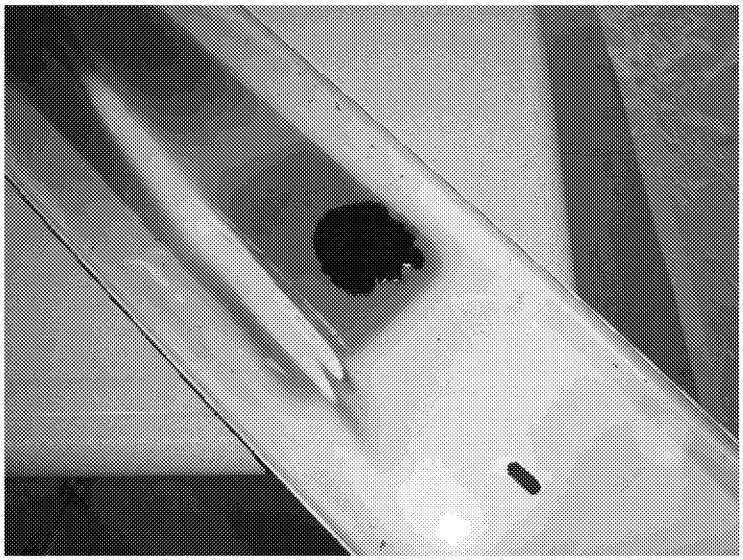
Depending on the manufacturer, the age of the ballast, and whether the ballast is thermally protected, leaks can be noted in several areas. We have found that Universal ballasts are likely to leak from the corner.

Tar-like Globules





Leaked Potting Material



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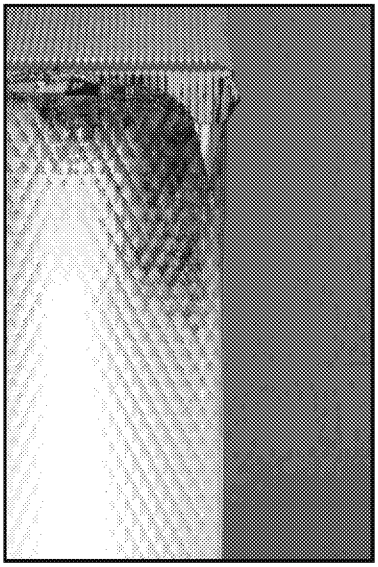
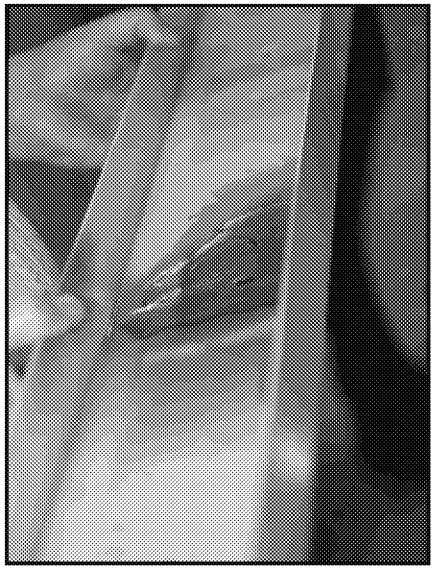
Sometimes it leaks as a liquid – especially with very hot ballasts

Oily Stains





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If you notice, the person holding the tray is not using any personal protective equipment and should have been wearing gloves

Ballasts Come in Various Sizes

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Here are some ballasts from one school. You can see that many different sizes and models are in use.

“Box” Type Fixture

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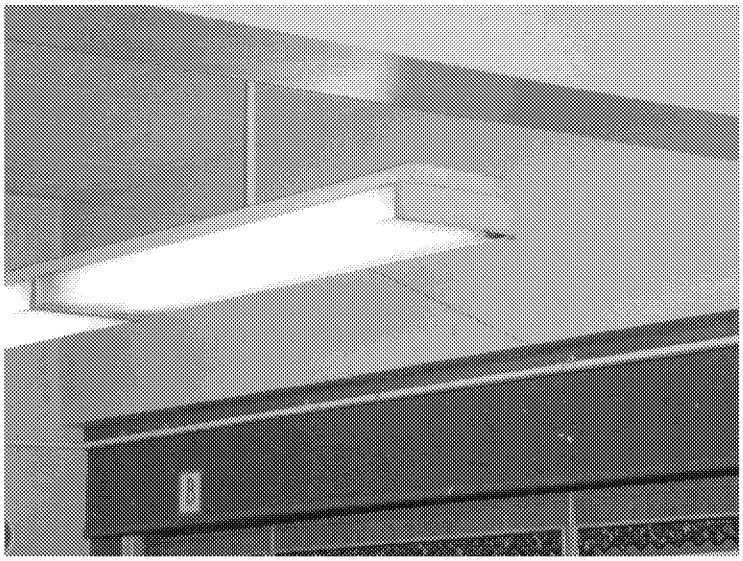
There are several common types of fixtures

“Wrap Around” Type Fixture



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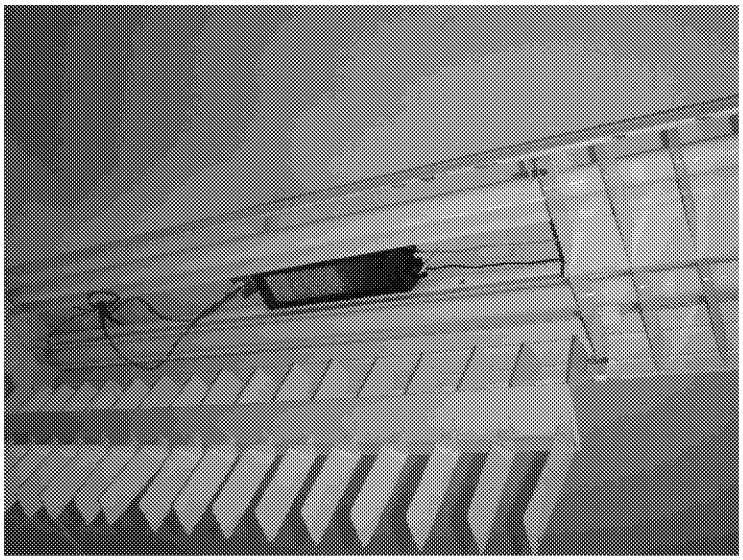
Sometimes the leaked material can travel into the adjoining fixture.

“Egg Crate” Type Fixture



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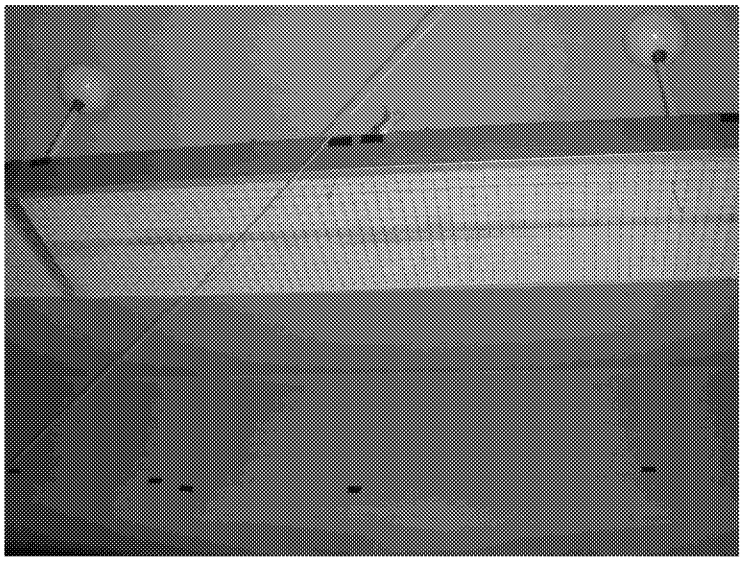
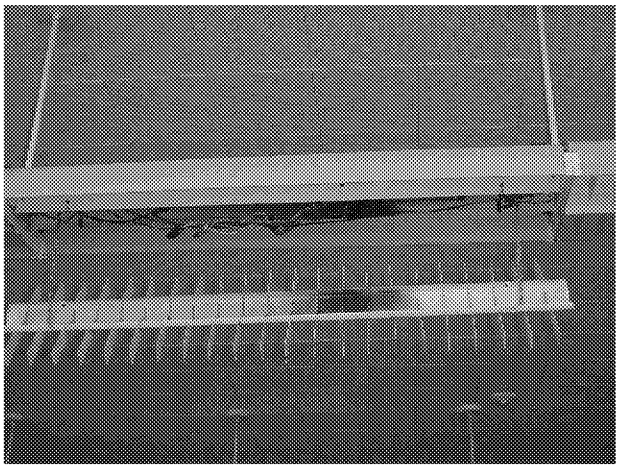
With the “egg crate” type fixtures, it is often difficult to see leaked material without opening the fixture.

“Honeycomb” Type Fixture



Ballast Location



Health and Safety Issues

- Only an experienced contractor or specially trained staff should be the only ones working on potential PCB light fixtures
- Follow standard operating procedures for working around electrical fixtures as required
- Follow all requirements and precautions if there are asbestos issues.
- Move desks and equipment from underneath the fixture
- Place plastic sheeting under the work area

Personal Protective Equipment

At minimum wear:

- Eye Protection – Safety glasses
- Skin Protection – Nitrile gloves, long-sleeve shirt, hat

When working with leaking PCB lighting fixtures, additional protection may be necessary based on the specific situation. If unsure how to proceed, you should contact the Health and Safety manager for the facility

Proper Storage and Disposal

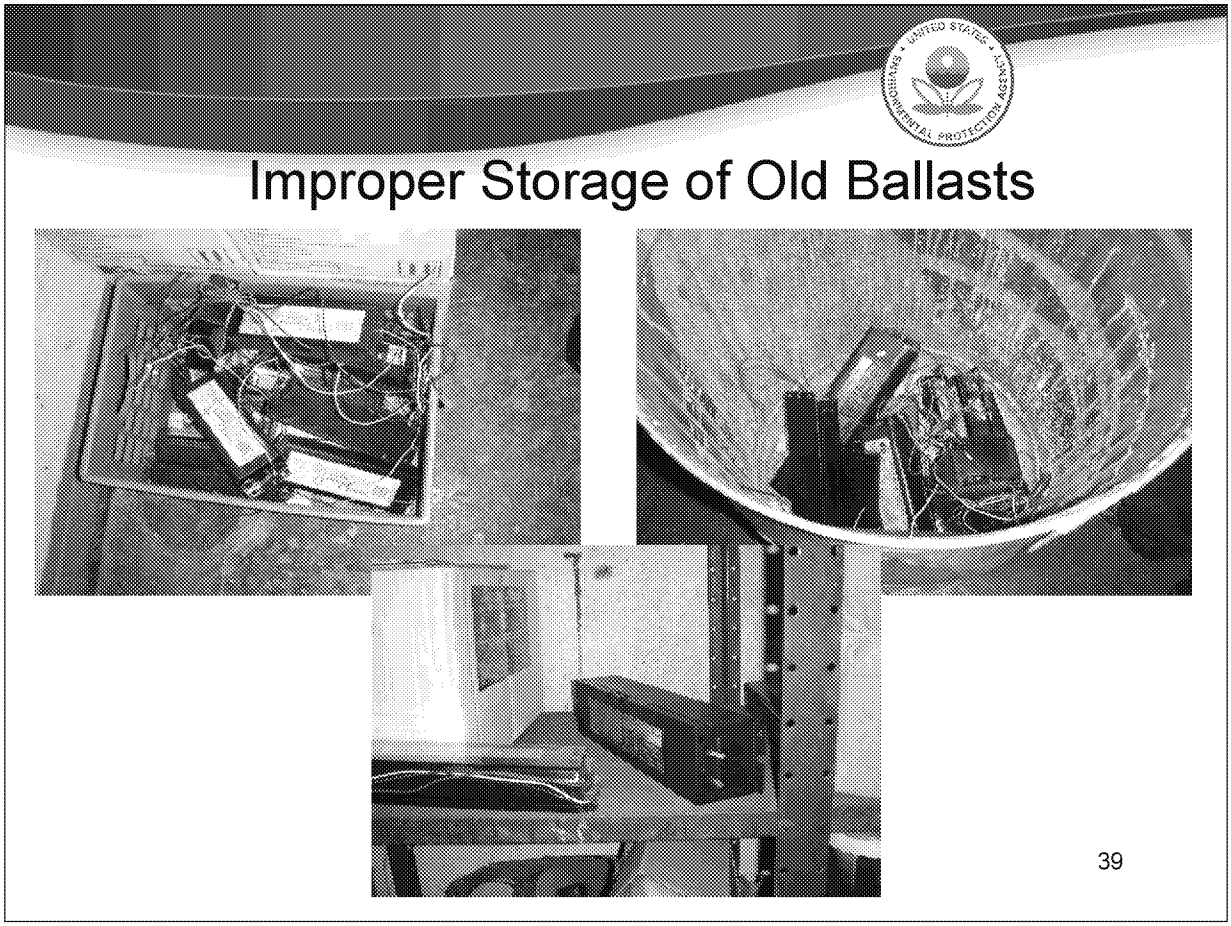
- Disconnect and remove all ballasts and fixtures as appropriate as well as incidental PCB-contaminated items, fluorescent tubes from the light fixture housing and compartments;

- Provide the appropriate containers and packing materials for packaging and storing the four possible types of waste streams:

  - Intact, non-leaking, PCB-containing ballasts;
  - Leaking PCB-containing ballasts and cleanup wastes generated by handling and decontaminating areas where leaking ballasts were discovered;
  - Ballasts that contain no PCBs; and
  - Fluorescent light bulbs.

Proper Storage and Disposal, Cont.

- Maintain a record for each space where lighting fixtures are removed including how many leaking vs. non-leaking PCB-containing ballasts were removed from each space
- Package and label drums according to federal, state, and local regulations.
- Store the drums until a transporter currently licensed for transportation of PCB waste removes them to the appropriate disposal facility.
- Ballasts that are totally enclosed and not leaking can currently be disposed of in a solid waste landfill. However, most landfills will not accept such waste so most will be disposed of in a TSCA approved landfill or destroyed using chemical or thermal destruction methods.



Sometimes they are stored in milk crates trash cans or just left on a table for anyone contact. Note the new ballast sitting next to the old one that leaked

Any leaking ballast has to be treated as a TSCA waste and needs to be handled and stored properly.

Removed Fixtures not Labeled or Stored Properly

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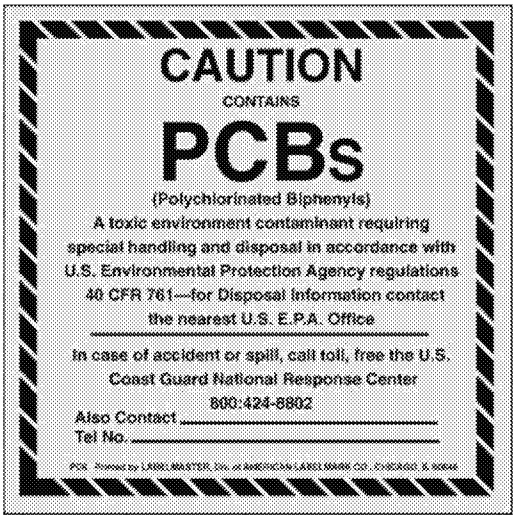
In this example, all of the removed fixtures are individually wrapped and stored in a locked area until they are picked up for proper disposal in a TSCA landfill. These light fixtures were wrapped correctly, but had the incorrect identification sticker and were left in the fire pump room. The should be stored in a secure room with a curb or other protection and not have floor drains.

Proper PCB Identification Sticker

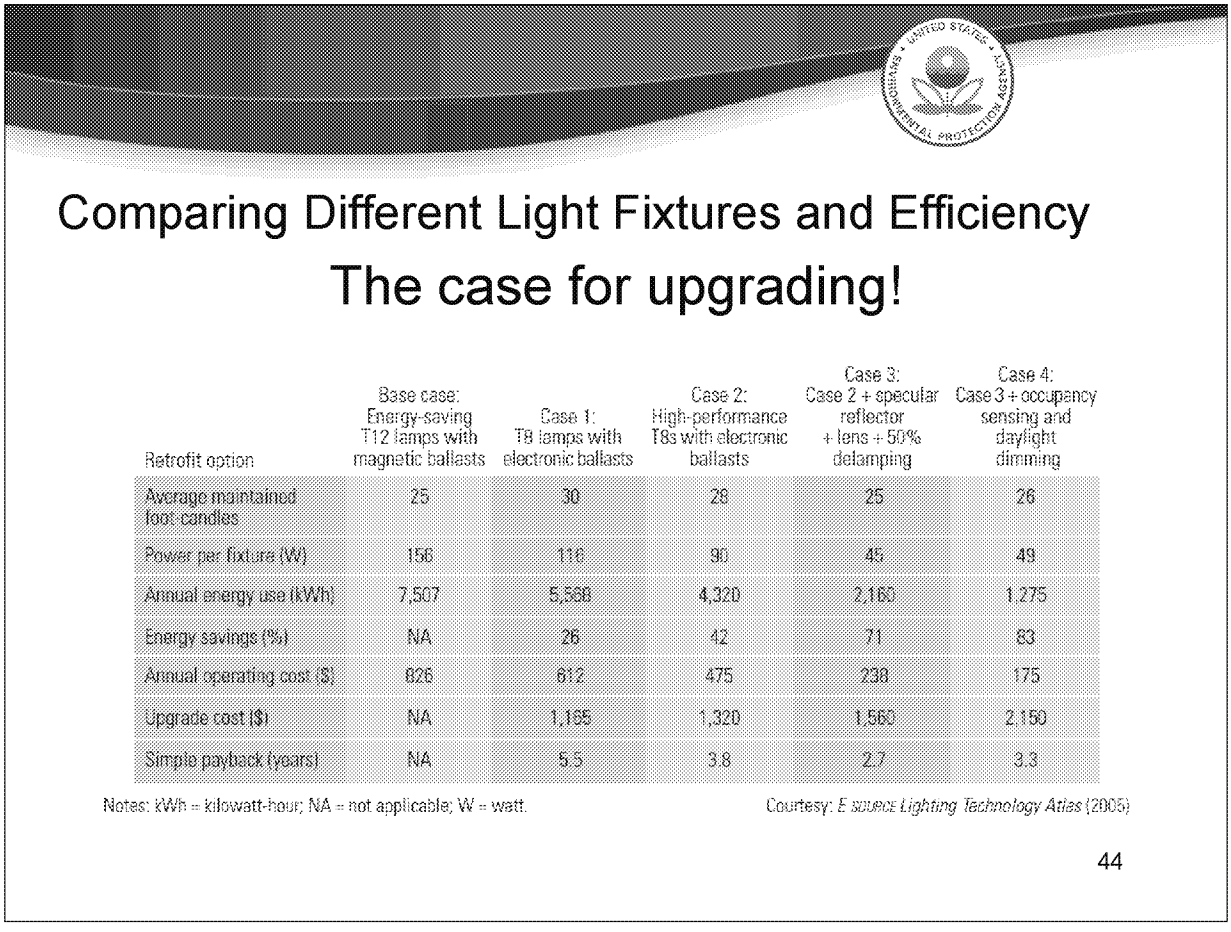


Proper Methods for Storing Ballasts

Benefits of PCB Light Fixture Replacements

- A significant reduction of PCBs in the air
- Expected reduction in energy consumption and saving tax dollars
- Improved classroom lighting
- Job creation

“



Comparing Different Light Fixtures and Efficiency

The case for upgrading!

Retrofit option	Base case: Energy-saving T12 lamps with magnetic ballasts	Case 1: T8 lamps with electronic ballasts	Case 2: High-performance T8s with electronic ballasts	Case 3: Case 2 + specular reflector + lens + 50% delamping	Case 4: Case 3 + occupancy sensing and daylight dimming
Average maintained foot candles	25	30	28	25	26
Power per fixture (W)	156	116	90	45	49
Annual energy use (kWh)	7,507	5,568	4,320	2,160	1,275
Energy savings (%)	NA	26	42	71	83
Annual operating cost ($)	826	612	475	238	175
Upgrade cost ($)	NA	1,165	1,320	1,560	2,150
Simple payback (years)	NA	5.5	3.8	2.7	3.3

Notes: kWh = kilowatt-hour; NA = not applicable; W = watt.

Courtesy: *E source Lighting Technology Atlas* (2005)

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The case for upgrading from T-12s to T-8s
This table is Performance comparison of fluorescent retrofit options
Packages of lighting-efficiency measures such as high-performance lamps and ballasts, delamping, and controls achieve deep savings with attractive economics. In each case, it is assumed that a minimum illumination level of 25 foot-candles is maintained and that lamps are replaced at burnout.

Power per fixture (W) – is decreased in each case for T8 lamps from 156W in T12s, While in T8s go from 116W, 90W, 45W, and 49W

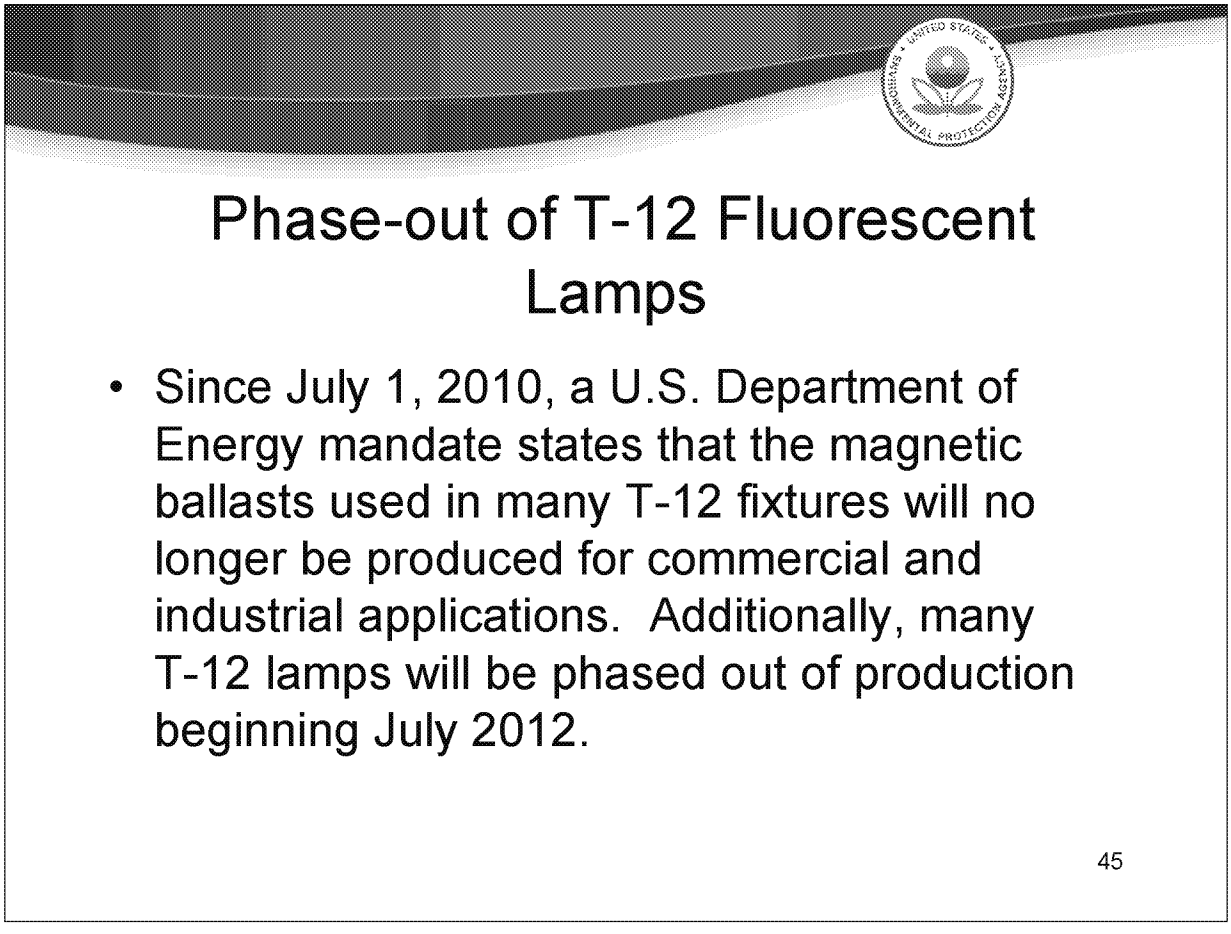
Annual energy use Kwh – has also shown to decrease significantly

Energy savings - Increase

Cost of operating the lamps – definite decrease annual operating cost.

The only one time cost is an upgrade cost. In each case the cost depends on the amount of technology
Such as high performance lamps, specular reflector + lens, occupancy sensors, or daylight dimming technology

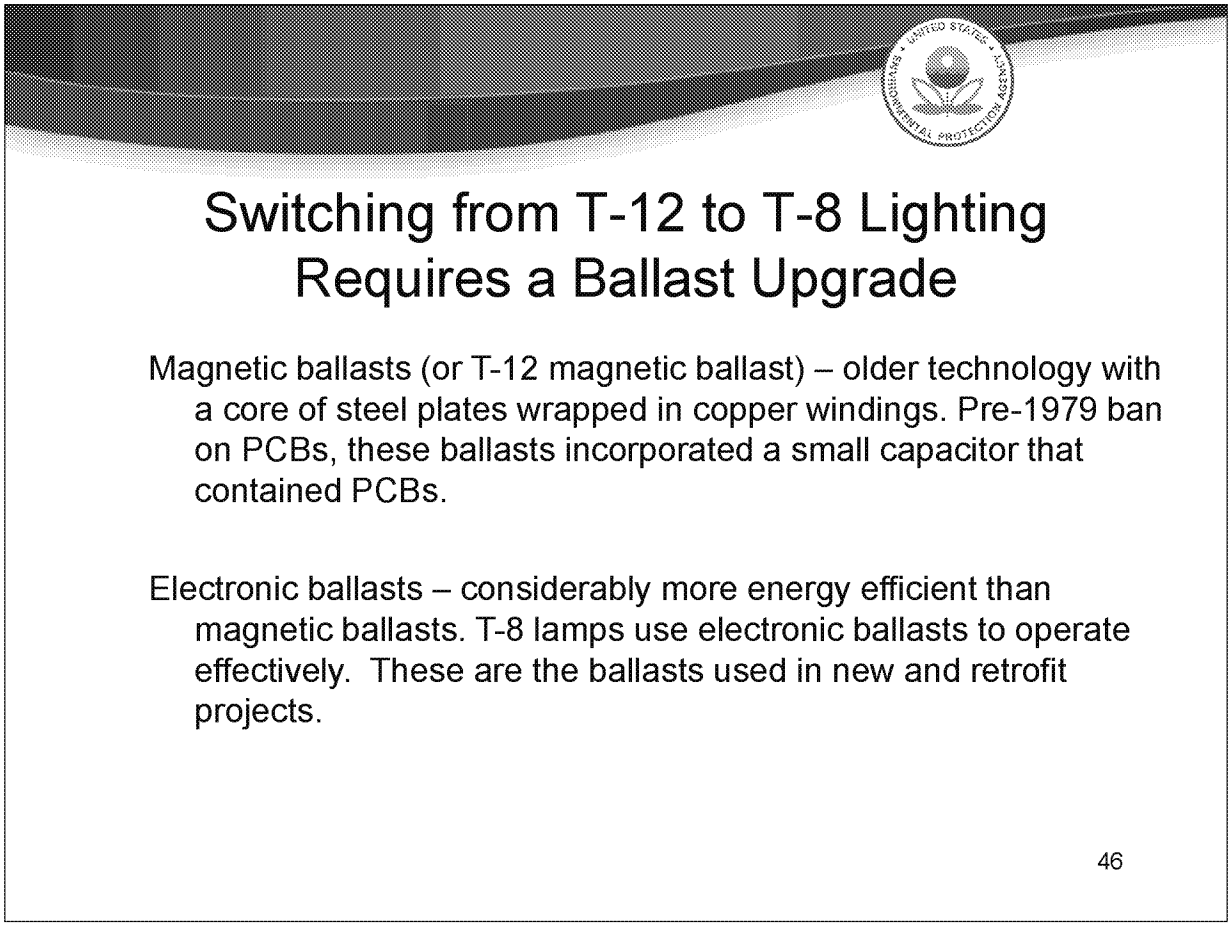
And payback ranges from 3 to 5 years. After that the school gets to keep the savings.



The Phase out of T-12s

Why are T-12 fluorescent systems being phased out?
T-12 lamps and magnetic ballasts are considered outdated compared to today's T-8 and T-5 fluorescent technologies, which are far more energy efficient. The phase-out is to remove less efficient T-12 fluorescent system from the marketplace and encourage commercial and industrial facilities to switch to more energy efficient technology.

About the Phase-Out
Approximately 30% of all fluorescent lamps sold in the United States are T12 technology
Nearly 70% of all T-12 fluorescent lamps sold in the United States will be phased out by July 2012
You can expect the cost of the remaining T-12 products in the marketplace to increase in the near term, as replacement supplies dwindles and lighting manufactures turn their attention to producing more energy-efficient products, such as high-performance T-8 and T-5 systems



Switching from T-12 to T-8 lighting requires a ballast upgrade

Ballast – is a device intended to limit the amount of current in an electric circuit, to light a fluorescent lamp
Magnetic ballasts (or T-12 magnetic ballast) – older technology with a core of steel plates wrapped in copper windings. Pre-1979 ban on PCBs, these ballasts incorporated a small capacitor that contained PCBs. Some of these ballast may leak PCB and continue to operate and may be prone over heat and spark a fire.

Electronic ballasts – considerably more energy efficient than magnetic ballasts. T-8 lamps use electronic ballasts to operate effectively. These are the ballasts used in new and retrofit projects. These ballast are also smaller and run much cooler.

ESCOs and Performance Contracts

- ESCOs are "businesses that develop, install, and arrange financing for projects designed to improve the energy efficiency and maintenance costs for facilities" –National Association of Energy Service Companies

- An energy savings performance contract (or simply, performance contract) is an agreement between a building or facility owner or occupant and a performance contractor (i.e. the ESCO). The contractor identifies, designs, and installs energy conservation measures and guarantees their performance.

- "The more energy-cost savings generated, the more the performance contractor earns — and **the more money the school has to put toward other projects**." –US Dept. of Energy

How Performing Contracting Works

- Payment for financing the energy conservation project is recovered from the energy cost savings
- The ESCO(s) may completely cover the upfront costs of the project and then are repaid by energy saving alone
- Or the building owner/occupant pays a portion of the upfront costs of the project

Summary of K-12 Case Studies on the National Association of Energy Service Companies' (NAESCO) website

ESCO	School District	City	State	Energy Improvement	Cost	Estimated Annual Cost Savings	Estimated Annual Energy Savings
McClure	East Lyoming	Hughesville	PA	Lights, HVAC, hot water	Not Available	Not Available	Not Available
Atlantic Energy	Mechanicville	Saratoga Springs	NY	Lights, HVAC, hot water	$1.27 million	$71,000	546,000 kwh
Chevron	Oxford Community	Oxford	MI	Lights, HVAC, hot water, servers	$2.9 million	$262,000	1,368,000 kwh
PEPCO	Baltimore	Baltimore	MD	Lights, HVAC, hot water, windows	$2.9 million	$114,000	Not Available
Chevron	Hatsboro	Horsham	PA	Lights, HVAC	$1.16 million	$110,000	938,000 kwh
CTS Group	Scotland	Memphis	MO	Lights, HVAC, hot water, heat pump	Not Available	$46,800	Not Available
ConEdison	Windham	Windham	CT	Lights, HVAC, hot water, windows	$5.24 million	$528,000	Not Available

K-12 Energy Improvement Case Studies

- School districts across the country have undertaken energy improvement projects including lighting replacements that have resulted in real cost and energy savings.

- Case studies can be found on the National Association of Energy Service Companies' (NAESCO) web site at: http://www.naesco.org/resources/casestudies/default.aspx

Case Study: Buffalo Public Schools

- The Buffalo Public School District in Buffalo, NY entered into a 20 year, multi-phase performance contract with Johnson Controls
- 65 facilities renovated to improve energy efficiency
- $71 million in projected energy savings

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